

CLAIMS

We claim:

- 1 1. A semiconductor structure, comprising:
 - 2 a first substrate;
 - 3 a second substrate joined to the first substrate;
 - 4 a plurality of contacts between the first substrate and
 - 5 the second substrate; and
 - 6 a plurality of first solder bumps connected between the
 - 7 first substrate and the second substrate for aligning the
 - contacts.
- 1 2. The semiconductor structure according to claim 1,
2 wherein the contacts have a different composition than the
 first solder bumps.
- 1 3. The semiconductor structure according to claim 1,
2 wherein at least one of the first substrate and the second
 substrate is an integrated circuit chip.
- 1 4. The semiconductor structure according to claim 1,
 wherein the contacts comprise second solder bumps.

1 5. The semiconductor structure according to claim 4,
2 wherein the second solder bumps have a smaller size than the
first solder bumps.

1 6. The semiconductor structure according to claim 1,
2 wherein the contacts have a smaller size than the first
solder bumps.

1 7. The semiconductor structure according to claim 1,
wherein the contacts comprise electrically conductive epoxy.

1 8. The semiconductor ~~structure~~ according to claim 1,
wherein the contacts comprise a polymer-metal composite.

1 9. The semiconductor structure according to claim 1,
2 wherein the contacts comprise at least one member selected
3 from the group consisting of dendrites and self-interlocking
micro connectors.

1 10. The semiconductor structure according to claim 1,
2 wherein the contacts each have a diameter of less than about
50 μ m.

1 11. The semiconductor structure according to claim 1,

wherein the contacts each have a diameter of about 10 μm .

1 12. The semiconductor structure according to claim 1,
2 wherein the contacts each have a diameter of less than about
 10 μm .

1 13. The semiconductor structure according to claim 1,
wherein the contacts have a pitch of less than about 100 μm .

14. The semiconductor structure according to claim 1,
wherein the contacts have a pitch of about 30 μm .

1 15. The semiconductor structure according to claim 1,
2 wherein the contacts have a diameter about 20% of the
diameter of the first solder bumps.

1 16. The semiconductor structure according to claim 1,
2 wherein the contacts comprise a material having a higher
melting point than the first solder bumps.

1 17. The semiconductor structure according to claim 1,
2 wherein an upper surface of the contacts and an upper
surface of the first solder bumps are co-planar.

1 18. The semiconductor structure according to claim 1,
2 further comprising:

3 a ledge on at least one of the first substrate and the
4 second substrate, wherein the first solder bumps are
5 arranged in contact with the ledge, such that an upper
6 surface of the contacts and an upper surface of the first
solder bumps are co-planar.

1 19. The semiconductor structure according to claim 1,
wherein the contacts comprise a material other than solder.

1 20. The semiconductor structure according to claim 1,
wherein the contacts comprise solder.

1 21. The semiconductor structure according to claim 1,
wherein the contacts comprise PMC.

1 22. The semiconductor structure according to claim 1,
2 wherein the contacts provide optical communication between
the first substrate and the second substrate.

1 23. The semiconductor structure according to claim 1,
wherein the contacts comprise a waveguide.

1 24. The semiconductor structure according to claim 1,
2 wherein the contacts comprise an optical transmitter and an
3 optical receiver.

1 25. The semiconductor structure according to claim 1,
2 wherein at least one of the first substrate and the second
3 substrate is an integrated circuit chip, and the contacts
4 are sufficiently small to permit alignment of individual
5 devices on the integrated circuit chips.

1 26. A method of fabricating a semiconductor structure,
2 the method comprising:

3 providing a first substrate and a second substrate;

4 providing contacts on one of the first substrate and
5 the second substrate;

6 providing first solder bumps on one of the first
7 substrate and the second substrate;

8 mounting the first substrate on the second substrate;
9 and

10 reflowing the first solder bumps for surface tension
11 aligning of the contacts.

1 27. The method according to claim 26, wherein the
2 contacts have a different composition than the first solder

bumps.

1 28. The method according to claim 26, wherein at least
2 one of the first substrate and the second substrate is an
 integrated circuit chip.

1 29. The method according to claim 26, wherein the
contacts comprise second solder bumps.

1 30. The method according to claim 29, further
2 comprising:

3 reflowing the second solder bumps, wherein the second
4 solder bumps ball up to make contact between the first
substrate and the second substrate.

1 31. The method according to claim 29, wherein the
2 second solder bumps comprise a material having a higher
3 melting point than the first solder bumps, and reflowing the
4 second solder bumps requires heating the second solder bumps
5 to a higher temperature than reflowing the first solder
bumps.

1 32. The method according to claim 29, wherein the
2 second solder bumps are provided with a smaller size than

the first solder bumps.

1 33. The method according to claim 26, wherein the
contacts comprise electrically conductive epoxy.

1 34. The method according to claim 26, wherein the
contacts comprise a polymer-metal composite.

1 35. The method according to claim 26, wherein
2 reflowing the first solder bumps draws the first substrate
3 toward the second substrate to cause the contacts to make
contact with the first substrate and the second substrate.

1 36. The method according to claim 26, wherein the
2 first solder bumps contact the first substrate and the
3 second substrate prior to the contacts making contact
between the first substrate and the second substrate.

1 37. The method according to claim 26, wherein the
contacts are provided by thin film processing.

1 38. The method according to claim 37, wherein the thin
2 film processing comprises lift off stencil or subtractive
etch.

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1 39. The method according to claim 26, wherein the
2 contacts each are provided with a diameter of less than
about 50 μm .

1 40. The method according to claim 26, wherein the
2 contacts each are provided with a diameter of about 10 μm .

1 41. The method according to claim 26, wherein the
2 contacts each are provided with a diameter of less than
about 10 μm .

1 42. The method according to claim 26, wherein the
2 contacts are provided with a pitch of less than about 100
 μm .

1 43. The method according to claim 26, wherein the
2 contacts are provided with a pitch of about 30 μm .

1 44. The method according to claim 26, wherein the
2 contacts are provided with a diameter about 20 % of the
diameter of the first solder bumps.

1 45. The method according to claim 26, wherein the
2 contacts are provided with a smaller size than the first

solder bumps.

1 46. The method according to claim 26, wherein the
2 contacts provide optical communication between the first
substrate and the second substrate.

1 47. The method according to claim 26, wherein the
contacts comprise a waveguide.

1 48. The method according to claim 26, wherein the
2 contacts comprise an optical transmitter and an optical
receiver.

1 49. The method according to claim 26, wherein the
2 contacts comprise at least one member selected from the
3 group consisting of dendrites and self-interlocking micro
connectors.

1 50. The method according to claim 26, wherein the
2 contacts and the first solder bumps are provided such that
3 an upper surface of the contacts and an upper surface of the
first solder bumps are co-planar.

1 51. The method according to claim 26, wherein the

2 contacts comprise at least one member selected from the
3 group consisting of solder, a material other than solder,
and PMC.

1 52. The method according to claim 26, further
2 comprising:

3 providing a ledge on at least one of the first
4 substrate and the second substrate, wherein the first solder
5 bumps are arranged in contact with the ledge, such that an
6 upper surface of the contacts and an upper surface of the
first solder bumps are co-planar.

1 53. The method according to claim 26, wherein the
2 contacts are compressed as the first solder bumps are
reflowed.

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